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## Appendices

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# Appendix A

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Excerpted from: *The Study of Wastewater Management Alternatives in the Occoquan Watershed of Loudoun County*. Camp, Dresser and McKee for the Loudoun County Sanitation Authority, June 1986, pp. 102- 1-7 and 11-3, 11-4.

## Conclusions

1. 20-year average daily wastewater flow for the year 2010 are estimated to be 2.7 mgd for the Loudoun County portion of the Occoquan Watershed and about 2.0 mgd for the Loudoun County upper Broad Run Watershed. By the year 2040, average daily wastewater flows in the two watersheds are estimated to increase significantly, ranging from approximately 10 mgd for the Occoquan Watershed within Loudoun County to about 7.6 mgd for Upper Broad Run.

2. Alternative No. 1 - Construction of pumping stations, force mains, and gravity sewers to convey wastewater from the Loudoun County portion of the Occoquan Watershed to the existing UOSA wastewater treatment plant is technically feasible. This is the least costly alternative with an estimated present worth cost of about 56 million dollars. However, a high degree of uncertainty exists regarding implementability, which is contingent upon the following items:

a. Fairfax County approval of rights-of-way for Loudoun County sewers in Fairfax County to connect to the UOSA wastewater collection system along Cub Run.

b. Approval by all four UOSA member jurisdictions of a request by Loudoun County to become a member of UOSA and to be allocated required capacity in the treatment plant.

c. In the event that Loudoun County chose not to seek membership in UOSA, the approval by a participating UOSA jurisdiction of the

purchase of long-term capacity in the UOSA treatment plant.

d. State Water Control Board approval of capacity in excess of 40 mgd at the UOSA wastewater treatment plant.

Benefits of Alternative No. 1 include the possibility of serving the Cub Run and Ellick Run subwatersheds in the Loudoun County portion of the Occoquan Watershed by about 1989. Disadvantages of Alternative No. 1 include the uncertainty about implementability, heavy reliance upon commitments by other jurisdictions to convey and accept Loudoun County flow at UOSA, and the lack of total County control over the operation and expansion of the treatment facility.

3. Alternative No. 2 - The use of the Potomac Interceptor and Blue Plains for wastewater generated after year 2000 in Loudoun County is not a viable alternative unless the Authority's service agreement with the District of Columbia can be amended. Beginning in the year 2000, Loudoun County discharges to the Potomac Interceptor and Blue Plains will be limited to the year 2000 flow. Thus, a major disadvantage of Alternative No. 2 is that it does not provide for treatment capacity to serve the Loudoun County Occoquan and Upper Broad Run Watersheds for a 20-year period.

4. Alternative No. 3 - Construction of a new 3.0 mgd advanced wastewater treatment plant in the Loudoun County portion of the Occoquan Watershed is technically feasible. The required design would be similar to the existing UOSA treatment facility to meet the stringent effluent water quality standards of the Occoquan Watershed Policy. Of the four wastewater management alternatives considered, Alternative No. 3 was estimated to have the greatest present worth cost (about 66 million dollars). Another disadvantage of Alternative

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No. 3 is that permanent wastewater service would not be available in the Loudoun County portion of the Occoquan Watershed until 1992. Benefits of the alternative include total County control over the operation and expansion of the treatment facility and no reliance on other jurisdictions to convey and accept flow from the Occoquan Watershed of Loudoun County.

5. Alternative No. 4 - Construction of a new 5.0 mgd advanced wastewater treatment plant in the Upper Broad Run Watershed of Loudoun County to serve both the Loudoun County portion of the Occoquan Watershed and the Upper Broad Run Watershed is technically feasible. The plant would not be required until the year 2000 because the Authority could rely upon its available capacity in the Potomac Interceptor to serve future development through the year 2000, with additional treatment capacity required to handle flow increases after 2000. The alternative was estimated to be the second least costly wastewater management alternative with a total present worth cost of about 65 million dollars, assuming a treatment plant with a design very similar to the UOSA treatment plant to satisfy the stringent requirements of the existing Dulles Area Watershed Policy (DAWP). If the DAWP treatment standards are relaxed by the State Water Control Board at a later date to match the recommendations in a recent study the Northern Virginia Planning District Commission, it is likely that the present worth cost for this alternative could be reduced by as much as 6 million dollars. Thus, future changes in DAWP treatment standards could conceivably reduce the present worth cost for Alternative No. 4 to a level which is only about 5 percent greater than the least cost alternative (No. 1).

Alternative No. 4 would provide the County with complete control over the operation and future expansion of the treatment facility. The alternative would be in compliance with the Dulles Area Watershed Policy, which recommends a regional treatment plant location within the Broad Run Watershed of Loudoun County. The treatment facility could also serve other portions of the Authority's service area in

addition to Dulles International Airport and possibly Fairfax County. Another advantage of this alternative is the reduced risk of adverse water quality impacts since the treatment plant will discharge to a stream/river system rather than a reservoir system, like the Occoquan Reservoir. As a result, there should be less uncertainty about regulatory agency approval of a Loudoun County discharge and future treatment plant expansions in comparison with the options which involve increasing wastewater discharges into the Occoquan Reservoir. A disadvantage of the alternative is that all flows generated within the Occoquan Watershed of Loudoun County would have to be pumped into Broad Run Watershed. The alternative would require the greatest number of wastewater pumping stations and force mains of the three feasible alternatives studied.

6. Watershed Policies - Alternative Nos. 1 and 3 involve wastewater treatment facilities discharging to the Occoquan Watershed. Alternative No. 4 would discharge to the Dulles Area Watershed. Effluent quality standards will be more stringent for treatment facilities located in the Occoquan Watershed than in the Dulles Area Watershed. In addition, the State Water Control Board is currently reevaluating the effluent quality standards established by the Dulles Area Watershed Policy which could result in the relaxation of some existing treatment standards.

7. Alternative No. 1 is the least-cost alternative. If minimizing costs is the primary concern of Loudoun County, Alternative No. 1 is the best approach despite the relatively high level of uncertainty and risk associated with this option.

8. The amount of uncertainty and risk associated with each wastewater management alternative should also be a very important factor in the evaluation and selection of a plan for Loudoun County. The Authority needs to embark upon a reasonably reliable course of action as soon as possible to satisfy short-term wastewater service needs which include projected Occoquan Watershed flows on the

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projected Occoquan Watershed flows on the order of 1.0 mgd by 1990. At the same time, the plan selected by the Authority should offer a high degree of certainty that there will be treatment capacity available to handle the very significant increase in wastewater flows after 2010. By far, Alternative No. 4 promises the least amount of uncertainty and risk over the long-term as well as the short term. This is primarily because Alternative No. 4 involves a discharge to a stream/river system rather than a reservoir system which is considered to be the most critical water resource in northern Virginia. As a result, there is less uncertainty about regulatory

agency approval of a Loudoun County discharge to Broad Run in comparison with regulatory decisions about the ultimate capacity limit for existing or future wastewater treatment plants in the Occoquan Watershed. Further, under Alternative No. 4, Loudoun County does not have to rely upon commitments from other jurisdictions for conveyance system routes or treatment plant operations and expansions. Therefore, if reducing the amount of uncertainty and risk associated with future wastewater services is of paramount concern to Loudoun County, Alternative No. 4 is the best approach despite the higher costs.

**Table A**  
**Selection Criteria Matrix for Wastewater Management Plans**  
**Occoquan and Upper Broad Run Watersheds of Loudoun County**

Selection Criteria	Alternative No. 1	Alternative No. 3	Alternative No. 4
	<ul style="list-style-type: none"> <li>• 2.67 mgd from Loudoun County Occoquan Watershed to UOSA (year 2010)</li> <li>• 1.95 mgd from Upper Broad Run Watershed to Blue Plains (year 2010)</li> </ul>	<ul style="list-style-type: none"> <li>• 2.67 mgd from Loudoun County Occoquan Watershed to new 3.0 mgd WWTP (year 2010)</li> <li>• 1.95 mgd from Upper Broad Run Watershed to Blue Plains (year 2010)</li> </ul>	<ul style="list-style-type: none"> <li>• 4.62 from Occoquan and Upper Broad Run Watersheds in Loudoun County to new 5.0 mgd WWTP in Upper Broad Run (start operation in year 2000). Use Potomac Interceptor from 1990 to 2000.</li> </ul>
1. Total Present Worth Cost (1986 dollars)	\$55,980,00	\$65,680,000	\$67,700,000
2. Initial Capital Cost (1986 dollars)	\$37,240,000	\$39,300,000	\$43,090,000
3. Expected Date of Operation	Cub Run Subwatershed-1990 Ellick Run Subwatershed-1990 Foley Branch Subwatershed-1992 Upper Broad Run Watershed-1990	Cub Run Subwatershed-1992 Ellick Run Subwatershed-1992 Foley Branch Subwatershed-1992 Upper Broad Run Watershed-1990	Cub Run Subwatershed-1990 Ellick Run Subwatershed-1990 Foley Branch Subwatershed-1990 Upper Broad Run Watershed-1990
4. County Control Over Facility Operation and Expansion	Very little County control since UOSA to treat Occoquan Watershed of Loudoun County and Blue Plains to treat Upper Broad Run watershed.	Complete Authority control for new WWTP in Occoquan Watershed of Loudoun County. Little control over treatment operation for flow from Upper Broad Run watershed to Blue Plains via Potomac Interceptor.	Starting in year 2000, complete County control for new WWTP in Upper Broad Run Watershed. For 1990 to 2000, little County control since flow from Occoquan and Upper Broad Run Watersheds discharged to Blue Plains via Potomac Interceptor.
5. Environmental Impacts	Increased discharge to Occoquan Watershed via UOSA has potential for greater long term water quality impact. Also, uncertainty regarding the ultimate capacity to be approved by regulatory agencies for UOSA WWTP. No significant water quality impacts expected for discharge to Blue Plains.	Increased discharge to Occoquan watershed has greater potential for long term water quality impact in comparison with new discharge to Broad Run. As a result, there is greater uncertainty about future regulatory rulings on future capacity. No significant water quality impacts expected for discharge to Blue Plains.	No significant water quality impacts expected if new WWTP discharge meets effluent quality standards established by Dulles Area Watershed Policy. For period 1990-2000, no adverse water quality impacts expected for discharge to Blue Plains.
6. Ability to Accommodate Future Wastewater Flow Beyond Year 2010	Expansion potential limited by stringent water quality standards in Occoquan Reservoir and wastewater needs of UOSA members.	Expansion potential limited by stringent water quality standards in Occoquan Reservoir and wastewater needs of UOSA members.	Expansion not limited by Broad Run or Potomac River quality. Larger WWTP size has been established by Dulles Area Watershed Policy.

# Appendix B

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PHILIP A. SOLEN  
County Administrator

TELEPHONE: 777-0200

COMMONWEALTH OF VIRGINIA  
**COUNTY OF LOUDOUN**  
OFFICE OF COUNTY ADMINISTRATOR  
18 NORTH KING STREET  
LEESBURG, VIRGINIA 22076

FLORENTINE A. MILLER  
Asst. County Administrator  
JAMES R. KEENE, JR.  
Asst. County Administrator

At a meeting of the Board of Supervisors of Loudoun County, Virginia, held in the Board of Supervisors' Meeting Room, 18 North King Street, Leesburg, Virginia, on Tuesday, February 17, 1987, at 1:30 p.m.

PRESENT: Betty W. Tatum, Chairman  
Andrew R. Bird, III, Vice-Chairman  
Charles A. Bos  
James F. Brownell  
Thomas S. Dodson  
Ann B. Kavanagh  
Frank I. Lambert  
Steve W. Stockman

IN RE: POLICY LEGISLATIVE COMMITTEE REPORT/WASTEWATER MANAGEMENT  
ALTERNATIVES IN THE OCCOQUAN

Mr. Dodson moved approval of the recommendation of the Policy Legislative Committee that the Board of Supervisors adopt the following resolution supporting the concept of a sewage pumpover from the Cub Run Watershed to the Blue Plains Interceptor at such time as the Cub Run Watershed is designated as a growth area in the comprehensive plan:

WHEREAS, the Loudoun County Board of Supervisors had requested the Loudoun County Sanitation Authority to negotiate with Fairfax County and the Upper Occoquan Sanitation Authority for interim capacity in the Occoquan Sewage Treatment Plant for treatment of sewage generated in the Cub Run Watershed of Loudoun County; and

WHEREAS, the Loudoun County Sanitation Authority has reported to the Loudoun County Board of Supervisors that Fairfax County and the Upper Occoquan Sanitation Authority will not negotiate with them concerning capacity in the Occoquan Sewage Treatment Plant until the Loudoun County Board of Supervisors provides assurances of its intent to assume responsibility for treatment of sewage generated in the Cub Run Watershed of Loudoun County; and

WHEREAS, the Cub Run Area Management Plan now under consideration by the Cub Run Area Citizens' Committee recommends a level of development which would require central sewer service; and

WHEREAS, the Board of Supervisors of Loudoun County recognizes its responsibility to plan community facilities consonant with the efficient and economical use of public funds and to protect against undue density of population in relation to community facilities; and

WHEREAS, the best data currently available indicates that the most practical method for Loudoun County to provide sewage treatment for the Cub Run Watershed area of Loudoun County is by means of a pumpover from the Cub Run Watershed to the Blue Plains Interceptor, or to an Advanced Wastewater Treatment Plant in the Broad Run Watershed; and

WHEREAS, a pumpover from the Cub Run Watershed to the Blue Plains Interceptor, or to an Advanced Wastewater Treatment Plant in the Broad Run Watershed at such time as the Cub Run Watershed is designated as a growth area in the Comprehensive Plan for Loudoun County would facilitate the efficient and economic use of public funds and would protect against undue density of population in relation to community facilities; and

WHEREAS, the Loudoun County Sanitation Authority, for its engineering and financial planning purposes, has requested direction from the Board of Supervisors of Loudoun County.

NOW, THEREFORE, BE IT RESOLVED by the Board of Supervisors of Loudoun County, Virginia that:

The Board of Supervisors of Loudoun County supports the concept of a pumpover from the Cub Run Watershed to the Blue Plains Interceptor or to an Advanced Wastewater Treatment Plant in the Broad Run Watershed as a means of sewage disposal at such time as the Cub Run Watershed area of Loudoun County is designated as a growth area in the Comprehensive Plan for Loudoun County; and

BE IT FURTHER RESOLVED that:

This in no manner is to be construed as a support for, or commitment to, the redesignation of the Cub Run Watershed at this time. Additionally, this in no manner is to be construed as support for, or commitment to the redesignation or development of the Elk Lick Watershed, Foley Branch Watershed, or Upper Broad Run Watershed, all of

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Management Alternatives in the Occoquan


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which lie within Planning Policy Areas designated  
as Rural Fringe and which shall remain so  
designated until such time as the Comprehensive  
Plan for Loudoun County may be amended.

Seconded by Mr. Brownell.

Voting on the motion: Supervisors Tatum, Bird, Bos, Brownell,  
Dodson, Kavanagh, Lambert and Stockman - Yes; None - No.

A COPY TESTE:

  
COUNTY ADMINISTRATOR FOR THE  
LOUDOUN COUNTY BOARD OF SUPERVISORS

mlt:2/17/87



# Appendix C

**Table B**  
**Road Network: Cub Run Planning Area • November 18, 1987**

Road	Termini	Lanes Right of way	
1. Route 50	Fairfax County Line to West of Route 742	6 lanes - divided 200' ROW plus land required for Route 606 interchange	<p>Freeway. E6R, limited access. All at-grade access will be terminated when road becomes a freeway. Clover interchange at Route 606. 60 mph design speed. Western terminus of freeway outside Cub Run Area.</p> <p>Pre-freeway description. U6D, a 6 lane median divided major arterial. Controlled access. 55 mph design speed. Left and right turn lanes required at all intersections.</p>
2. South Parallel Road (new road)	Route 609	4 lanes - divided 120' ROW	U4R, controlled access median divided Major Collector. Left and right turn lanes required at all intersections. 800' desirable distance between median crossovers. 45 mph design speed. Western terminus of road outside the Cub Run area.
3. South Access Road (new road)	Route 609 - Route 742	4 lane - undivided 70' ROW	U4, Minor Collector. 40 mph design speed. 52' curb face to curb face width. Intersection with route 609 to be located to accommodate safe distance to future Route 50 interchange ramp gore points.
4. North Access Road (new road)	Fairfax County Line to West of Cub Run Area	4 lanes - undivided 70' ROW	U4, Minor Collector. 40 mph design speed. 52' curb face to curb face width. Intersection with route 609 to be located to accommodate safe distance to future Route 50 interchange ramp gore points.
5. Route 639	North Access Road - South Parallel Road	4 lanes - undivided 70' ROW	U4, Minor Collector. 40 mph design speed. 52' curb face to curb face width. At-grade intersection to be maintained at Route 50 until such time Route 50 becomes limited access freeway. Left and right turn lanes, with appropriate ROW, required at Route 50 intersection. Overpass to be provided over Route 50 when it becomes a limited access freeway.
6. Route 639	North Access Road Terminus South of Dulles Airport	4 lanes - undivided 60' ROW	L4, Local Industrial Access Road. 35 mph design speed. Cross section consistent with VDOT standards.
7. Route 609	North Access Road - South Parallel Road	4 lanes - divided 120' ROW	<p>U4R, Major Collector. Limited Access. North Access Road - South Access Road when Route 50 interchange is constructed.</p> <p>Pre-Freeway Description. U4R Controlled Access Major Collector. Left and right turn lanes required at all intersections. 800' desirable distance between median crossovers. 45 mph design speed. Present alignment relocated to provide through connection with South Parallel Road.</p>
8. Route 609	North Access Road - Terminus South of Dulles Airport	4 lanes - undivided 70' ROW	U4, Minor Collector. 52' curb face to curb face width. 40 mph design speed.
9. Route 609	South Parallel Road - Fairfax County Line	4 lanes - undivided 70' ROW	U4, Minor Collector. 52' curb face to curb face width. 40 mph design speed. Present alignment to be relocated to provide T intersection with South Parallel Road.
10. Route 742	Route 50 - Fairfax County Line	2 lanes - undivided 60' ROW	R2, Local Road. 24' pavement width, shoulders. 40 mph design speed. At-grade intersection to be maintained at Route 50 with appropriate turn lanes until such time Route 50 becomes a limited access freeway, at which time Route 742 will be cul-de-sac'd south of Route 50.
11. Local Access Roads	Connections with roads described above to be determined.	Consistent with County and VDOT standards	The location and geometric sections of these local roads will be determined in conjunction with County/VDOT review of development applications. Geometric sections must meet County and VDOT standards.

## Appendix C

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### **Transportation Glossary: Cub Run Area Management Plan**

**E6R:** A 6-lane road with limited access also with a raised median.

**U6D:** A 6-lane divided road with roadside curb and gutter and a depressed median.

**U4R:** A 4-lane divided road with curb and gutter and a raised median. The pavement width of each 2-lane directional section will generally be 27 feet. Sidewalks should be provided in areas where substantial pedestrian movements are anticipated.

**R4R:** A 4-lane divided road with shoulders and drainage ditches and a raised median.

**U4:** A 4-lane undivided road with curb and gutter. Forty-eight feet of pavement is generally required with two 2-foot gutters for a total curb face - curb face width of 52 feet.

**L4:** Similar to a U4 section but with narrower pavement widths. Curb face - curb face widths of 40 feet - 48 feet depending on projected traffic volumes and adjoining land uses.

**R2:** A 2-lane road, 20-24 feet of pavement with shoulders and drainage ditches.

## Appendix D

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### Setback Study Based on Cone-of-Vision

The development setback along Route 50 in the Cub Run Planning area has been established to increase road safety as well as to create a pleasing visual image along this important highway corridor and entrance to Loudoun County. Accordingly, the relationship between the driver and his view of the road has been an important factor in determining an appropriate setback for buildings from the road. This relationship is described in *Visual Values for the Highway User*.

*"The driver is, in a sense, a captive. His view is controlled by the direction of the highway and limited by the windshield size. As his speed increases, other restrictive effects occur.\**

1. As speed increases, concentration increases.
2. As speed increases, the point of concentration recedes.
3. As speed increases, peripheral vision diminishes.
4. As speed increases, foreground detail begins to fade.
5. As speed increases, space perception becomes impaired.

These effects have been documented\*\* and can be transferred to a cone-of-vision template which simulates the width and length of the driver's view in relation to his direction and speed of travel as he moves along the highway (see Figure A). The elements in the environment can be assessed for their relative visual impact, based on their location in relation to the driver during his travel.\*\*\*\*

A cone-of-vision template similar to the one illustrated in Figure A was used in conjunction with maps of the Cub Run Planning area to determine those areas which would appear in the driver's field of vision as a car travels along Route 50 at 50 mph. A second template was then used to evaluate which areas within this vision cone are most visually significant.

Figure B illustrates the hierarchy of visual significance within a driver's cone-of-vision. "As the driver directs his view to the focal point, the effects of the visual field decrease in direct relation to the distance of the components from the driver."\*\*\*\*\* Therefore, the higher the value assigned to an area in the cone-of-vision diagram on page 65, the greater will be the visual impact of features appearing in that zone of a driver's view. Using a template based on a 50 mph travelling speed to study the Cub Run planning area, it was found that the most significant views along Route 50 would fall within approximately 300' to either side of Route 50. Hence, a 300' development setback is encouraged in the planning area in an effort to improve the most visually significant portion of the Route 50 corridor.

Within this setback it is important to create a sense of visual edge along Route 50 which will help contain and direct the driver's view of the road. The importance of visual edge is discussed below:

*"Manipulation of visual edge...offers a major opportunity to organize roadside components for specific driver view needs. Visual edge may be manipulated to guide the driver's tasks of steering, movement and information control, as well, as to enhance his pleasurable visual experiences.\*\*\*\*\**

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\* Hamilton, Jr. and Thuston, L. L. as reported and discussed in Tunnard and Pushkarev, *Man-Made America: chaos or control?*, p. 173.

\*\* Ibid., p. 173.

\*\*\* U. S. Department of Transportation, Federal Highway Administration, *Visual Values for the Highway User*, by Peter L. Hornbeck and Garland A. Okerlund, Jr., (1973), p. 114.

\*\*\*\* Ibid., p.115.

\*\*\*\*\* Peter L. Hornbeck, et al., *Highway Aesthetics - Functional Criteria for Planning and Design*, Harvard University, Cambridge, Mass., 1968, p.108.

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*Visual edge is produced by the location of roadside elements (i.e., vegetation, structures, topography, etc.) as perceived by the driver. Rather than reacting to each individual element, the driver generally responds to overall views of many edge factors which appear as large masses or lines.”\**

A visual edge can assist in increasing the aesthetic quality of the Route 50 corridor and improving motorist’s understanding of the highway itself. the visual edge created by the roadside landscape helps focus a driver’s attention and aids visual comprehension of the route being traveled. Visual conditions at the road’s edge ideally will minimize undesirable distractions and assist the driver by providing

information which will help the driver react safely to highway conditions. “Awareness of speed and motion helps motorists drive safely within desired limits.”\*\* A sense of visual edge and enclosure will create an index of speed as passing objects “whiz by”. This concept will be very important in the Cub Run planning area where there are open fields along Route 50 which give motorists little sense of an “edge”. In other areas, structures appear too close to the road, creating a sense of encroachment rather than edge. These elements of visual edge, along with the development setback proposed for the Cub Run planning area, will assist in modifying the Route 50 corridor to achieve a cohesive, attractive, distraction free entrance to Loudoun County.

\* *Visual Values for the Highway User*, p. 97.

\*\* *Ibid.*, p. 98.

